A PROPOSAL TO THE NASA 2011 UNIVERSITY STUDENT LAUNCH INITIATIVE

A Study of Atmospheric Properties as a Function of Altitude

By
HARDING FLYING BISON
2011 USLI ROCKET TEAM

October 1, 2010

Matthew Irvine, Team Leader

Edmond Wilson, Ph.D., Team Official

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1 SCHOOL INFORMATION

1.1 Name of School/organization and title of project

A Study of Atmospheric Properties as a Function of Altitude

1.2 Name and Title of Team Official

Edmond W. Wilson, Jr., Ph.D., Professor of Chemistry, Harding University, Searcy, AR 72149

1.3 Name and Title of the Safety Officer

Edmond W. Wilson, Jr., Ph.D., National Association of Rocketry (NAR) Member Number #86424, NAR HPR Certification Level 2, Expires October 2011.

1.4 Student Participants

1.4.1 Number of Student Participants

Student Team Members: Seventeen team members, including one high school student and representing seven majors: mechanical engineering (6), biology (2), computer science (1), electrical engineering (2), economics (1), print journalism (1), management information systems (1) make up the Harding University Flying Bison 2010 USLI Rocket Team.

1.4.2 Project Organization Chart

Table 1. Table of Participants, Managers and Allocation of Human Resources

Team Official		**Project Progress Manager**		**Safety Officer**
Edmond Wilson		Matthew, Mgr.		Edmond Wilson
Airframe	**Publications/Outreach**	**Science Payload**	**Avionics**	**Business**
Taylor, Mgr.	Kendra., Mgr.	Emilia, Mgr.	Grant, Mgr.	Tim, Mgr.
Jeff	Daniel	David	Shawn	Daniel
Mannie	Elizabeth	Andrew	Taylor	
Shawn	Morgan	Jonathan		
Ben		Grant		
Patrick				

1.4.3.1 Duties of Airframe Division

- Choose hybrid motor and airframe to achieve project goals
- Model rocket flight using RockSim 9 to aid in motor/airframe choice
- Coordinate with Motor, Payload, and Avionics Divisions to insure airframe can accommodate all necessary component parts
- Conduct tensile strength and compression testing of airframe components
- Conduct wind tunnel tests of a scale model of rocket
- Build and paint airframe
- Supervise installation/integration of motor, payload, avionics and components into airframe

1.4.3.2 Duties of Motor Division

- Order and maintain all hardware and materials necessary for motor installation, ignition, flight, recovery and maintenance, including fuel, oxidizer and expendables
- Prepare a procedures check list for preparation of the rocket for flight
- Prepare a safety document for motor, fuel and oxidizer transportation, flight preparation, ignition, flight, recovery, maintenance and stowage
- Carry out static motor firings to measure thrust and record spectra of exhaust plumes

1.4.3.3 Duties of Science Payload Division

- Design and build the science payload, an atmospheric spectrometer
- Choose embedded microcontroller to operate spectrometer
- Interface science payload with microcontroller and write operational software
- Laboratory test science payload/microcontroller complete
- Field test science payload before USLI competition
- Write procedure for deployment of science payload
- Install science payload into the airframe
- Recover science payload, download data
- Interpret data and prepare a science report from the results

1.4.3.4 Duties of Avionics Division

- Acquire G-Wiz and Perfect Flight computers and instruction manuals
- Learn operation of flight computers
- Laboratory test flight computers as a function of air pressure and prepare calibration charts
- Install flight computers into airframe
- Download flight data after recovery of rocket and report to USLI field committee

1.4.3.5 Duties of Launch Operations Division

- Launch Operations Division responsible for preparing an inventory of all materials, supplies and equipment to be transported to USLI competition launch site
- Set up rocket preparation area
- Set up rocket launch platform
- Maintain supply of nitrous oxidizer and all equipment needed to fill oxidizer tank on rocket
- Maintain temperature of nitrous tanks for optimum safe operating pressure
- Maintain and deploy ignition system; charge batteries, test ignition system
- Prepare detailed list of all steps in rocket preparation, mounting on launch platform and carrying out pre-launch tests of ignition system, oxidizer system, avionics system and payload system
- Notify USLI Range Officer when Harding Flying Bison Rocket ready for launch
- Fire rocket under command from USLI range officer
- Clean rocket prep area and stow all equipment and supplies on van after launch and recovery

1.4.3.7 Duties of Outreach/Publications Division

- Design and maintain the 2010 Harding Flying Bison USLI Rocket Team website
- Upload PDR, CDR, FRR and Final Report to the website at required times
- Organize and carry out outreach activities at area schools
- Organize and carry out badge-related outreach activities with Girl Scout and Boy Scout troops
- Prepare article about USLI competition for Harding University Bison Newspaper
- Prepare information for organizations editor of Harding Petit Jean Yearbook
- Prepare safety manual for Flying Bison USLI 2010 Rocket Team
- Record and maintain minutes of meetings of Flying Bison
- Keep a photographic/video file of this year Flying Bison activities
- Seek external funding for carrying out the team's goals
- Recruit students for next year's Flying Bison team

1.5 National Association of Rocketry Section Sponsor

Mid-South Rocket Society NAR Secton #550, Marie Holyfield, Secretary-Treasurer
Ph: 901 340 8586, meholyfield@att.net, 9180 Fletcher Trace Pkwy, Lakeland, TN 38002

2 FACILITIES/EQUIPMENT

2.1 Description of Facilities and Hours of Accessibility

The team has access to a large shop containing metal and woodworking tools, a science laboratory with electronic test equipment and tools, and an additional shop with tensile strength instrument and wind tunnel. There are several computer laboratories in the Pryor-England Science and Engineering Center available for student use. All facilities, shops, and computer laboratories items are open and available from 7 a.m. to 10 p.m. These facilities are described in detail below.

2.2 Resources for Designing and Building Rocket and Science Payload

2.2.1 Expert Personnel Available

David Stair is a retired NASA model maker and is expert in designing models, fixtures, and electronics equipment. He is also an outstanding graphics artist and has helped us in each of the four preceding years of the competition. Edmond Wilson, Team Official, has extensive experience in electronics and optics instrument building and calibration. Wilson has successfully directed the Harding Flying Bison USLI Rocket Team for all four years of its existence and is proficient in metal working shop skills. He is an expert using National Instruments hardware and software as well as MatLab software. Brad Miller, Assistant Professor of Engineering, is proficient in wind tunnel operation, tensile strength measurements, and SolidWorks software.

2.2.2 Facilities Available

The planned research and experimentation can be accomplished using existing equipment and facilities available to the Flying Bison Rocket Team at Harding University. Adequate laboratory space, 1400 sq. ft., is available for the proposed rocket and payload design and assembly. In addition, a 27 ft. by 30 ft. machine shop for construction of the rocket and its payload is at the disposal of the team. All facilities, shops and computer laboratories items are open and available from 7 a.m. to 10 p.m.

2.2.3 Equipment

Shop equipment includes a 9" x 42" ENCO Turret Vertical Mill with digital electronic readout, EMCO Compact 10, Swiss made, Lathe, Ramco Vertical/Horizontal Metal Cutting Bandsaw, Phase II 8-inch rotary table with Phase II Tailstock and 18" Vertical Metal-Cutting Bandsaw. Also, a variety of woodworking equipment, including a Delta 10" Contractor's Saw with 30" Biesemeyer Fence, Delta 6" Jointer, 14" Craftsman Bandsaw and 15½" Craftsman Drill Press, is available for building the rocket airframe. Available for sheet metal work is an ENCO 48" Sheet Metal Pan & Box Brake and a Jet Bench Model Sheet Metal Roller, 2" x 48".

Also available is an Aerolab 12" x 12" x 14" Windtunnel and an INSRON 5569 Tensile Strength Instrument that can operate to 50 kN.

2.2.4 Supplies

Supplies are purchased on an "as needed basis." However, some supplies from previous competitions are available for use on this project.

2.2.5 Altitude Verification of Rocket Flight

The team will use a G-WIZ MC2 flight computer to monitor flight altitude. This will be in addition to the PerfectFlight miniAlt/WD flight computer.

2.3 Computer Resources, Communications, Software, and Web Site

The Harding University Rocket Team has at its disposal a number of computer labs that are available to students and faculty. Software needed and available in these computer laboratories are RockSim, SolidWorks, and Visual Studio. All of the rocket components, excess building supplies, and related materials from previous competition years are available for team use.

2.3.1 Computer Resources for Communication

All team members have more than adequate access to computers in order to maintain communications lines open. Many of the students have their own computers and all have web access in their dorm rooms. Moreover, cell phones with texting are taking over a large majority of communications between team members.

2.3.2 Computer Resources for Web Site Creation and Maintenance

There are more than adequate computer resources for web site creation. This is a non-issue

2.3.3 Document Development for Design Reviews

Five brand new HP 4510s Laptop computers, loaded with RockSim 9, Microsoft Word 2007, EXCEL 2007, SolidWorks 2009, MatLab 2009a, LabVIEW 8.6.1, are available to be used/checked out by Flying Bison Rocket Team use in carrying out engineering studies, science studies, flight simulations and report creation. This is in addition to the computer resources mentioned above.

2.3.4 Team Official – NASA USLI Project Lead E-mail Communications

The Team Official, Edmond Wilson, has the following contact information:

HU10849, Harding University, Searcy, AR 72149-0849
Office Phone: 501 279 4513 Cell Phone: 501 278 7268
E-mail: wilson@harding.edu FAX: 501 279 4706

Edmond Wilson will serve as the sole contact person representing the Harding Flying Bison 2010 USLI Rocket Team with the NASA USLI Project Lead.

2.3.5 Software Tools Available

All rocket team members have access to at least the following software:

RockSim 9 Microsoft Word 2007 EXCEL 2007
SolidWorks 2009 MatLab 2009a LabVIEW 8.6.1
Adobe PDF maker Google Chrome CorelDraw X4
PowerPoint 2007 StellarNet 2009

2.3.6 Video Teleconferencing Equipment

The Smart Classroom in the Harding University School of Education will be used for video conferencing. In this way, all members of the team can participate in the video reviews.

Additional teleconferencing equipment is available. Equipment manufactured by INSORS (www.insors.com), is located in Room 167 of the Pryor-England Science and Engineering Center. It will provide interactive video/audio feed. The computer equipment available for videoconferencing meets the minimum requirements indicated. This will be our back up system.

2.3.7 Preferred Teleconferencing with Marshall Space Flight Center (MSFC)

Final information to decide the answer to this question is being gathered and will be sent to NASA USLI Office as soon as available.

2.4 Implementation of Architectural and Transportation Barriers Compliance Board Electronic and Information Technology (EIT) Accessibility Standards

Harding University is actively implementing the requirements of the Americans with Disabilities Act Accessibility Guidelines, ADAAG. Renovations and new buildings are carried out so as to meet the American Disabilities Act, ADA and the American Barriers Act, ABA guidelines. Harding University presently meets presently meets most of the standards.

The Harding Flying Bison 2010 USLI Rocket team implements the Architectural and Transportation Barriers Compliance Board Electronic and Information Technology (EIT) Accessibility Standards (36 CFR Part 1194). In particular, it meets the Subpart B Technical Standards

- 1194.21 Software applications and operating systems (a-l)
- 1194.22 Web-based intranet and internet information and applications. 16 rules (a-p)
- 1194.26 Desktop and portable computers

The Team Official, Edmond Wilson, will work to accommodate any student with disabilities who wishes to be a member of the team in such a way that team members with disabilities have easy access to all rooms, equipment and software.

3 SAFETY AND MISSION ASSURANCE

3.1 National Association of Rocketry (NAR) Level 2 Certified Mentor

Edmond Wilson, Team Official, serves as the National Association of Rocketry (NAR) Level 2 Certified Mentor. I am the individual owner of the rocket for liability purposes and I will accompany the team and the rocket to the USLI launch in April 2010.

3.2 Written Safety Plan

3.2.1 Safety of Materials Used

A written safety plan will be prepared for the construction and deployment of the rockets used in this project. MSDS sheets for all chemicals will be included an appendix. Particular instructions will be prepared for each area of rocket construction and firing and this information will be used to educate the team members before they begin work.

Materials used in this project are listed below:

- Pre-glassed phenolic for the airframe, fiberglass for the nose cone, polyethylene for boat tail, tail cones

- Fiberglass for reinforcing airframe
- Epoxy glue for mating and securing airframe components
- Phenolic tubing for the couplers
- Plywood for the spacers and coupler bulkheads
- Steel for the hybrid motor casing and motor thrust rings, snap rings
- Graphite for motor nozzle
- Nitrous Oxide liquid and gas for rocket motor oxidizer
- Steel screws, eye-bolts, nuts, washers
- Aluminum for optical bench of science payload
- Glass for diffraction grating of science payload
- Electrical circuit boards for computers and data collectors
- Fiber optic cable (glass fiber + plastic coating) for science payload
- Spray can acrylic paint for painting the airframe
- Nylon for parachutes and shock cords
- FFFG Black Powder for ejection charges
- J-Tek 2' Electric Matches (www.electricmatch.com)
- Carbon composition resistors for motor ignition system
- Pyrodex Pellets for motor ignition system
- Hydroxyterminate polybutadiene, HTPB, for hybrid rocket fuel

3.2.2 Safety of Facilities Involved

Safety of the classrooms and laboratories are governed by the Safety Plan for Harding University. When using the machine shops or launching the rockets, students are required to wear protective eyewear, closed toed shoes and gloves (at their discretion). They are supervised and taught proper use of each machine.

3.2.3 Manager of Safety Plan

The Safety Plan Manager for our area of Harding University is Dr. Keith Schramm. He has received training in safety and is responsible for maintaining a safe environment for staff and students. Forms are used to record minor and major accidents in order to minimize future accidents. A Safety Plan document is located in several places in the area. One is located in the student computer work area. MSDS sheets are constantly being acquired and rules adjusted to improve the quality of the workplace.

3.2.4 Mitigations and Risk Assessment
3.2.5 Procedures for National Association of Rocketry (NAR) Personnel to Perform
3.2.6 Compliance with NAR High Power Safety Code Requirements
3.2.7 Performance of all Hazardous Materials Handling and Hazardous Operations
3.2.8 Plan for Briefing Students on Hazard Recognition and Accident Avoidance

Before each construction procedure, the team members will be briefed on hazard recognition and accident avoidance. This procedure will be conducted for pre-launch briefings, including action for misfires, non-firing motors, ballistic landing, etc.

3.2.9 Plan for Pre-Launch Briefings

Before each launch, the team members will be briefed on hazard recognition and accident avoidance. This procedure will be conducted for pre-launch briefings, including action for misfires, non-firing motors, ballistic landing, etc. This will be done by the Memphis Rocket Club Range Officer.

3.2.10 Inclusion of Caution Statements in Plans, Procedures, and Working Documents

All plans, procedures and working documents will include caution statements whenever hazards might be encountered. These will be marked in special bold type to draw attention to the potential for harm.

3.2.11 Control of Hazardous Materials

Hazardous materials used in this project will be stored in the chemical vault of the Harding University Department of Chemistry. Use of hazardous chemicals will be monitored by the Safety Officer in order to insure that they are handled in a reasonable safe manner.

3.2.12 MSDS Data Sheets Applicable to This Project

MSDS Data Sheets for each chemical used will be collected and a set placed in the shop where the chemicals will be used. Team members will be made aware of these sheets and told how to handle these materials in a safe and responsible manner.

3.3 Laws Regarding Unmanned Rocket Launches and Motor Handling

3.3.1 Federal, State, and, Local Laws Regarding Unmanned Rocket Launches and Motor Handling

Before each launch, the Safety Officer will review Federal, State, and Local Laws regarding unmanned rocket launches and motor handling. In addition, he will confer with the range officer of the launch site to insure that all Federal, State, and Local laws are observed.

3.3.2 Federal Aviation Regulations Regarding Unmanned Rocket Launches and Motor Handling

Before each launch, the Safety Officer will review Federal Aviation regulations regarding unmanned rocket launches and motor handling. In addition, he will confer with the range officer of the launch site to insure that all Federal Aviation regulations are observed. The use of a hybrid rocket system is advantageous for safety, because there are no legal requirements for the handling of the inert fuel grains. The components of the hybrid motor system are completely inert by themselves, and will only ignite when placed in the hybrid motor system. The oxidizer will be nitrous oxide. We have obtained the proper valves and regulators to control nitrous flow from a distance of 200 feet. Ignition of the motor will be effected from the same distance.

3.3.3 Handling and Use of Low-Explosives (Ammonium Perchlorate Rocket Motors)

Whenever Low-Explosives are used in rocket launches, all Federal, State and Local Laws and regulations will be observed. A recent court finding states that ammonium perchlorate rocket motors are not explosives and therefore not subject to federal law restricting use of low-power explosives. Any ammonium perchlorate rocket motors purchased will be stored in an appropriate case in the chemical vault of the Harding University Department of Chemistry. These rocket motors will be transported in the same case. Only enough motors will be obtained and stored as necessary to be used in a short amount of time for a particular event.

DOT regulations are not applicable to Contrail Rockets hybrid motors because the fuel grain is an inert thermoplastic, and all other rocket components are completely inert. Nitrous oxide will be acquired from racing supply stores in Little Rock or Memphis, TN in approved DOT tanks and stored in a locked laboratory (Room 142) used by the rocket team in the Harding University Department of Chemistry.

3.3.4 NFPA 1127 Code for High Power Rocket Motors (Fire Prevention)

A copy of NFPA 1127 Code for High Power Rocket Motors will be procured and all operations covered by the Code will be observed.

3.4 Capability to Purchase, Store, Transport and Use Rocket Motors

The Safety Officer will apply for an Explosives Transaction Record Form 5400.4, also known as the Yellow Sheet to insure the teams ability to legally purchase ammonium perchlorate rocket motors. The motors will be stored in a Type IV or equivalent magazine (See 27 CFR 55.210). The Searcy Fire Marshall will be notified orally before the end of the day on which storage of the explosive materials commenced and in writing within 48 hours from the time such storage commenced.

Hybrid motor casings and hardware manufactured by Contrail Rockets have been purchased previously; any fuel grain reloads can be purchased from the Contrail Rockets webstore and shipped via US Mail.

3.5 Security and Control of Rocket Motors While Traveling To and From USLI Rocket Competition

Security and Control of Rocket Motors While Traveling To and From USLI Rocket Competition will be handled by the Safety Officer alone.

3.6 Written Statement That Team Members Will Abide by Safety Regulations

All team members have read and signed a statement acknowledging that they are aware of and will follow the following regulations: Federal Aviation Regulations 14 CFR, Subchapter F, Part 101, Subpart C; Code of Federal Regulation Part 55; and NFPA 1127, "Code for High Power Rocket Motors." All team members will comply with any and all other state and local regulations. This statement is in Appendix B of this document.

4 TECHNICAL DESIGN

4.1 The outer diameter of the launch vehicle will be 6.109", with a full length of approximately 9.3 feet.

4.2 After rigorous component mass analysis, the projected weight of the rocket is 29.5 lbs, assuming a combined science payload and avionics weight of 5 lbs.

4.3 The motor for the launch vehicle will be a Contrail Rockets L369 hybrid rocket motor. This motor provides an average thrust of 361.7 N and total impulse of 3828 Ns. This motor is 54" long and 75mm in diameter. The fuel will be hydroxyterminated polybutadiene, HTPB, and nitrous oxide oxidizer.

4.4 Preliminary simulations predict an altitude no greater than 5700 feet. We allow this margin of ~350 feet above the target altitude to permit the inclusion of unforeseen weight in the building process.

5 EDUCATIONAL ENGAGEMENT

5.1 Educational Engagement Within the UCLI Team

Collegiate members of the team will be taught fundamentals of high powered rocket construction and encouraged to attain NAR Level 1 or 2 Certification. Each team member will contribute a written section of the PDR, CDR, FRR.

5.2 Outreach on Harding University Campus

We plan to have an exhibit of our rockets at the Harding University Library. In addition, we will make an announcement to our student body of 5000 to give some basic information about the UCLI competition.

5.3 Educational Outreach to Girl and Boy Scout Troups in Searcy

We will assist Girl Scout Troups in getting an Aerospace badge by teaching them about the science of exploring space. In order to help members of the local Boy Scout troup get a Space Exploration Badge, we will instruct them in the history and basic aspects of space exploration and rocketry.

5.4 Educational Outreach to Area Schools

Classes from various area schools will be given instruction in building and flying water bottle rockets. The water bottle rocket competitions will be paired with education in basic rocketry and planetary exploration in order to show the scientific basis of the activity. Sherry Wilson, currently a 1st grade teacher at Westside Elementary, has partnered in this with us for the past three years. We will also be partnering with other area schools and the literacy-promotion and mentoring project of the Harding chapter of the Roosevelt Institution.

6 PROJECT PLAN

6.1 Key Milestones

The Integrated Master Schedule in Figure 6-1 shows the workflow in order to achieve the key milestones (shown as diamonds).

Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Preliminary Design Report Due 19 Nov 2010	----------	--------◇					
Preliminary Design Review, PDR 6 Dec 2010	----------	----------	--◇				
Critical Design Report Due 24 Jan 2011	----------	----------	----------	----------◇			
Critical Design Review, CDR 2 Feb 2011	----------	----------	----------	----------	--◇		
Flight Readiness Report Due 21 Mar 2011	----------	----------	----------	----------	----------	--------◇	
Flight Readiness Review, FRR 28 Mar 2011	----------	----------	----------	----------	----------	----------◇	
USLI Launch Competition, 13-16 Apr 2011	----------	----------	----------	----------	----------	----------	-----◇
Post Launch Assessment Review, PLAR, 9 May 2011	----------	----------	----------	----------	----------	----------	----------
Test Launch of Scale Model with Science Payload Prototype	----------	---------◇					
Airframe Division							
Final Design of Airframe	----------	----------	-----◇				
Order Materials for Airframe	----------	----------	-------◇				
Conduct Testing of Airframe and Airframe Components	----------	---------◇					
Build and Paint Airframe	----------	----------	----------	----------	-------◇		
Motor Division							
Order Motor and Ignition Hardware and materials	----------	----------	--------◇				
Prepare Detailed Procedure for Motor Preparation and Flight	----------	----------	----------	----------	---------◇		
Prepare Safety Document for Motor, fuel and oxidizer transportation, flight preparation, ignition, flight, maintenance, stowage	----------	----------	----------	---------◇			
Static Testing of Rocket Motors	----------	----------	----------	----------◇			
Science Payload Division							

Design and Build Spectrometer							
Choose and Purchase Embedded Controller							
Integrate Spectrometer and Controller into Airframe							
Laboratory Test Spectrometer							
Prepare Operations Guide for Spectrometer							
Avionics Division							
Laboratory Test of Avionics Computers							
Install Flight Computers into Airframe							
Prepare Operations Guide for							
Launch Operations Division							
Prepare Inventory of Materials, Equipment, Supplies							
Order Needed Materials and Supplies							
Prepare Detailed Procedure for Launch of Rocket with Safety							
Test Launch Rocket in Memphis							
Prep and Launch Rocket at USLI Competition							
Recovery Division							
Use RockSim to Choose Recovery Parachutes and Supplies							
Purchase Parachutes and Supplies							
Integrate Recovery Hardware into Airframe							
Monitor Flight and Recover Rocket at Memphis							
Monitor Flight and Recover Rocket at USLI							
Outreach Division							
Design and Implement Harding Flying Bison USLI Website							
Outreach Project at Westside Elementary							
Outreach Project with Girls Scouts and Boy Scouts							
Prepare Safety Manual for Flying Bison USLI Rocket Team							
Carry Out and Record Publicity Projects							
Seek External Funding							
Recruit New Team Members							

Figure 6.1 Table of Workflow

6.2 Budget

Item	Amount	
Rocket Airframe		900.00
Parachutes and Safety Harness		100.00
Construction Hardware and Consumables		1000.00
Launch Equipment		150.00
Flight Computer		800.00
Materials for Science Payload		1100.00
Contrail Rocketry Hybrid Motor System and Reloads		900.00
Nitrous Oxide, Motor Fuel Grains, Launch Consumables		1000.00
NAR Level 1 and Level 2 Licensure		200.00
Outreach		100.00
Travel to Competition Launch at Marshall Space Flight Center (10 Travelers)		4000.00
Total Estimated Expense		**10250.00**

6.3 Source of Funding

A proposal to the Arkansas Space Grant Consortium for $8500.00 will be submitted at their November 2010 Meeting requesting funds for the Harding University Flying Bison USLI Rocket Team to participate in this year's competition. The committee has enthusiastically

supported this competition for the past three years. It is anticipated that our request will be funded for the full amount.

7 PLAN FOR SUSTAINABILITY

7.1 Providing and Maintaining Partnerships

The Harding Flying Bison USLI Rocket Team has never had any partnership. We tried to work with the Civil Air Patrol last year but could not find a place to demonstrate a rocket launch and they lost interest. We will try again this year. The team will try to establish a partnership with BEI in Little Rock, Arkansas. BEI is heavily involved in NASA missions that require precision pointing devices.

7.2 Engaging Younger Students in Rocketry

The Flying Bison team has recruited two Searcy High School students who desire to train for a aerospace career. They have worked faithfully from the beginning and are a valuable part of the team. Each year the number of participants on the team has increased and this trend is expected to continue. The team is looking forward to the time it can field two rocket teams for the USLI competition.

7.3 Funding Sustainability

The Harding Flying Bison USLI Teams have been funded for all three past years by the NASA/Arkansas Space Grant Consortium. This year should be no exception and an even larger amount of funding will be requested because of a larger number of participants and expanded outreach projects. The ASGC has been approved for an additional five years of support and so our financial base is secure as long as we produce a product worthy of funding.

7.4 Educational Engagement

Many of the team members will present oral and/or poster presentations of their work at the Arkansas Undergraduate Research Conference, the Arkansas Space Grant Consortium Annual Symposium, the Central Arkansas Chapter of Sigma Xi Annual Poster Competition and at a poster session of our research group at Harding University, all during April of 2010. We are developing a library of rocket books and copies of the NAR magazine for team members. We are expanding our project to include laboratory testing of many of the individual components of the competition rocket.

8 DELIVERABLES FROM THIS PROJECT

8.1 A scale model of the rocket design with a payload prototype. This model should be launched prior to the Critical Design Review (CDR). A report of the data from the flight and the model will be prepared for and brought to the CDR.

8.2 Reports and PowerPoint presentations due on November 19, January 24, and March 21 will be submitted to the Academic Affairs Office on schedule. Reports and presentations will be posted on the team Web site by the due date.

8.3 The Post-Launch Assessment Review (PLAR) for the rocket and payload will be submitted to the MSFC Academic Affairs Office no later than May 9, 2011.

8.4 The team will have a web presence no later than November 1, 2010. The web site will be maintained/updated throughout the period of performance. It will be judged at random times throughout the year.

8.5 Copies of any products developed (journal, 3-D animation, media coverage, video, scrapbook, etc.) will be displayed during launch.

8.6 An electronic copy of the comprehensive report pertaining to the implemented educational engagement activities will be presented.

8.7 A safety plan outlining how NAR safety requirements will be implemented and how safety will be incorporated into all manufacturing, testing, and launching activities will be prepared. The risk assessment will include such things as (but not limited to): risks associated with faculty support, school support, financial/sponsor support, use of facilities, partnering arrangements, schedule risks, risks associated with chosen designs. This will be updated throughout the program and presented at the Critical Design Review (CDR) and Flight Readiness Review (FRR). The initial plan will be due with the Preliminary Design Review on December 6, 2010.

8.8 A reusable rocket and science payload (available for NASA/MSFC display) prepared for launch in April of 2011. The team will prepare a Preliminary Design Review (PDR) (December 2010), Critical Design Review (CDR) (January 2011), Flight Readiness Review (FRR) (March 2011), and Launch (April 16, 2010). (Dates are tentative and subject to change.) The CDR and FRR will be presented to NASA at a time and location to be determined by NASA/MSFC Academic Affairs Office. The presentation will be done using Video Teleconferencing/Web casting capabilities and Microsoft PowerPoint 2007 presentations and should be available on the team Web site no later than 7 days prior to the review board meetings.

APPENDIX A

Short Resumes of Managers and Team Members (in alphabetical order by last name)

First Name and Middle Initial

Major:

Career Goal:

Experience:

Edmond Wilson, Team Official, Safety Officer

Experience: This is my forth year as organizer and Team Official for the Harding Flying Bison USLI Rocket Team. During this time I have constantly gained valuable knowledge in rocket construction and testing, particularly rockets that use hybrid motors. I have also participated as a NASA/EPSCoR researcher developing sensors for hybrid rocket motors. I have experience in spectroscopy of hybrid rocket exhaust plumes. I have achieved National Association of Rocketry, NAR, Level 1 and Level 2 Certification after building, launching and recovering two high powered rockets plus passing an examination on rules and regulations associated with high powered sport rocketry. I have served five years as a Solar System Ambassador for Jet Propulsion Laboratory in order to spread the interesting work

done by JPL and NASA.